VIGILANCE MONITOR SYSTEM

STATEMENT AS TO RIGHTS OF INVENTION MADE BY GOVERNMENT EMPLOYEES

This invention was made by a government employee. The United States Army, as represented by the Secretary of the Army, has determined pursuant to 37 CFR Part 501 to retain certain rights in this invention.

TECHNICAL FIELD

Alertness and vigilance of human operators, monitors, and guards over long periods of time can be critical for the safe operation of a variety of equipment, including, for example, transportation vehicles. Operator alertness and vigilance is also important in the efficient and safe monitoring of various industrial processes and numerous critical military tasks. Even highly motivated, well-trained individuals are unable to sustain optimum levels of alertness when they are required to be alert for long periods of time. When individuals are required to remain awake and alert during times when they are normally asleep (i.e., late evening, nighttime, and early morning hours), maintaining alertness and responding appropriately to the external environment becomes difficult. Individuals responsible for operating critical equipment such as power plants, heavy machinery, and public and private vehicles, including aircraft or military weapons for sustained periods of time frequently have lapses of attention and can even fall asleep while on duty. The consequences of fatigue and lapses in vigilance can be tragic not only for the responsible individual but also for passengers and the public at large. Appropriate preservatives and countermeasures for such lapses are often not available when the individuals in question are responsible for the operation or guidance of military equipment, commercial airliners, nuclear power plants, and other security systems.

Sustained vigilance is necessary for a variety of tasks including such military tasks as sentry duty, sonar and radar monitoring, and standing watch, and is essential in countless other operational settings. Personnel may be subject to surveillance or monitoring to avoid potentially catastrophic events. Adverse exposure to environmental conditions including high altitude, heat, cold, etc. may exacerbate reductions in alertness and vigilance attributable to normal day/night variations in mental alertness. Increased automation in many of these activities reduces the moment-by-moment demands on the individual and thereby temporarily increases boredom whereupon maintenance of alertness becomes more difficult.

Unobtrusive ambulatory devices for detailed monitoring of human vigilance are currently not available. Ambulatory devices capable of detecting actual psychological states of the individual to assess vigilance are also unavailable to intervene and prevent performance degradation or the onset of sleep or loss of vigilance.

Prior art monitoring activity monitors are described in U.S. Pat. Nos. 4,353,375 and 5,197,489 which record activity over specified blocks of time. However, they have no capability to record mental performance or intervene to modify human performance.

Other devices indirectly monitor vigilance by measuring physical position of the eyelid or head position and sound an alarm if a change in alertness is inferred. Such devices are incapable of monitoring directly human performance and cannot store data. They are unable to monitor ambient environmental conditions and do not employ a combination of inputs to modify vigilance. They are incapable of assessing levels of activity of processing such information and are incapable of intervening to assess decrements in alertness. Further, such apparatuses are believed incapable of taking into account the previous individual history of the wearer or the time of day or other conditions which could be used to optimize performance.

Circadian desynchronization is a related but separate problem. The present invention may be adapted to treat and correct circadian desynchronization. Circadian desynchronization occurs when individuals alter their typical daily activities and pattern of sleep; this often appears as jet lag.

Certain medical conditions such as blindness or central nervous system disease including Alzheimer's disease, also contribute to circadian desynchronization by upsetting the normal human rhythms of rest and activity.

SUMMARY OF THE INVENTION

The present invention is directed to an activity and alertness monitor which includes a stimulation and reaction detection function, and the capability of storing the stimulation/reaction information. The stimulation/reaction functions enable active intervention to interrupt degradation in vigilance and restore alertness. Signalling to third parties is contemplated for warning of failure or incipient failure.

Under control of a microprocessor-based controller, including data and program storage, information is collected from the ambient environment via an initial series of sensors. Additionally, the controller generates (under program control) certain stimuli which are transmitted to a human subject via stimulators and the reaction responses to these stimuli are sensed and returned to the controller by sensors. The controller controls all functions including keeping track of the time at which they occur and is adaptable to increase or decrease the number of stimulations depending on ambient conditions, time of day, history of the wearer, etc.

A primary object of the invention is to monitor the alertness and vigilance of human subjects and to detect degradations in such vigilance which may affect performance. Another object of the invention is to monitor ambient environmental conditions which would under ordinary circumstances be expected to contribute to decreased vigilance of the human subject. Another object of the invention is to automatically intervene and provide a warning to the wearer or others of degradation in mental performance of the wearer.

Another object of the invention is to warn individuals of lapses in their alertness via direct stimuli and to warn supervisors or other employees of degradation in alertness directly as by an audible tone, visual signal, or other stimuli or signal. These warnings may be telemetered to a location remote from the site of the wearer. Another object of the invention is to continuously record information related to the actual environmental conditions such as temperature, humidity, ambient illumination, sound levels, altitude, and so forth, which may affect human vigilance.

Another object of the invention is to control synchronization of human activity rhythms (circadian rhythms) to the external environment by regulating rest and alertness cycles.

Another object of the invention is to monitor and record for later evaluation the performance of personnel during operations requiring sustained vigilance without supervision. Examples of such personnel functions include sentries and night watchmen, so that supervisors and management personnel can be certain that individuals are regularly performing their assigned duties.

Another object of the invention is to monitor effects of environmental factors such as light, sound, and pollutants,